

CLAIMS:

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1. An elongated tapered nail for securing fractures of the proximal humerus comprising:
an elongated body having a curved shank configured to occupy an upper portion of
the proximal humeral shaft, and a contiguous butt portion extending proximally from the
shank and configured to occupy the humeral cortex;
the butt portion defining a plurality of transverse holes, such that the holes may
receive fasteners attached to fragments of the humeral cortex.
- 10 2. The nail of claim 1 wherein the curved shank includes a curved portion defining a curved
central axis comprising an arc, and wherein the curved portion comprises at least half of
the length of the shank.
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3. The nail of claim 1 wherein the butt portion defines a central axis and each of the
transverse holes is oriented on a respective hole axis, and wherein at least two of the hole
axes are angularly offset from each other by an acute angle.
4. The nail of claim 1 having a total length of less than 8 inches.
- 15 5. The nail of claim 1 defining a central axis having at least a curved portion, the axis
occupying a reference plane.
6. The nail of claim 5 wherein at least one of the transverse holes in the butt portion is
offset from the reference plane by an acute angle.
7. The nail of claim 5 wherein at least one of the transverse holes in the butt portion is
offset from the reference plane by less than 45 degrees.
- 20 8. The nail of claim 5 wherein at least one of the transverse holes in the butt portion is
offset from the reference plane by about 30 degrees.

9. The nail of claim 5 wherein the transverse holes in the butt portion include at least two holes angularly offset each by a respective angle from the perpendicular to the reference plane.
10. The nail of claim 1 wherein the elongated body defines a distal transverse hole and comprises a tip portion extending distally beyond the distal hole by at least one inch.
11. The nail of claim 1 wherein the elongated body defines a distal transverse hole and comprises a tip portion extending distally beyond the distal hole by a distance 20-50% of the total length of the nail.
12. The nail of claim 1 wherein the elongated body defines a distal transverse hole and comprises a tip portion extending distally beyond the distal hole, and wherein the tip portion is more tapered over at least a portion of its length than is the remainder of the body.
13. The nail of claim 1 having a profile that substantially passes within its own envelope.
- ~~14.~~ A humeral nail for securing fragments of a fractured proximal humeral cortex to a humeral shaft, the nail comprising:
 a curved tapered shank having a curved conical profile with a diameter that is a linear function of position along the shank, the shank having a proximal end having a first diameter, and a distal end having a smaller second diameter, with the shank having a substantially constant shaft taper angle therebetween; and
 the shank defining at least a first securement hole.
15. The nail of claim 14 further comprising a concavely tapered extending portion extending from the distal end of the shank, having a proximal end abutting the distal end of the shank at a transition;
 the extending portion having the second diameter at its proximal end to provide a continuous surface at the transition;

the extending portion having a greater taper angle at its proximal end than the shaft taper angle, such that the transition between the shaft and the concavely tapered portion comprises a convex crest; and

the extending portion having a taper angle that diminishes toward the distal end thereof.

20 16. The nail of claim 15 wherein the taper angle at the distal end of the extending portion is zero.

21 17. The nail of claim 15 further comprising a cylindrical terminal portion extending from the distal end of the extending portion and having a distal end comprising a rounded nose.

10 22 18. The nail of claim 17 further comprising a cylindrical butt portion extending from the proximal end of the shank and defining a plurality of second securement holes and an alignment element, such that the position of the securement holes may be determined by the position of the alignment element.

15 19. A method of manufacturing a humeral nail for securing fragments of a fractured proximal humeral cortex to a humeral shaft comprising the steps:

providing an elongated bar defining a central axis;

tapering at least a first portion of an intermediate portion of the bar, the intermediate portion comprising at least one-third of the length of the bar; and

20 bending the bar to form the entire intermediate portion into an arc, such that the portion of the central axis within the intermediate portion defines a curve.

20. The method of claim 19 including the step of providing a plurality of holes transverse to the central axis, at least two of the holes being angularly offset from each other about the axis by an acute angle.

21. The method of claim 19 including the step of cutting the bar to a predetermined length.

25 22. The method of claim 21 wherein the predetermined length is less than 8 inches.

~~23.~~ A method of implanting a humeral nail in a humerus having at least one broken fragment comprising the steps:

broaching a bore through the proximal head of the humerus, and extending the bore to an intermediate position within the humeral shaft;

5 inserting the nail into the bore;

securing a drilling jig to the nail;

drilling a plurality of transverse holes through the humerus and through the nail;

securing the nail to the shaft with a plurality of screws, each threadably engaging the humerus and passing through the nail; and

10 securing the fragment to the nail.

24. The method of claim 23 wherein the step of broaching the bore includes forming a curved envelope into which the nail may be inserted without substantially deforming either the nail or the humerus.

25. The method of claim 23 including the step of removing the nail after the bone has healed.

15 26. The method of claim 23 wherein the fragment comprises at least a portion of a humeral head, and wherein the step of securing the fragment includes passing at least two screws through the nail and securing the screws to the humeral head.

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